CLAIMS

What is claimed is:

1. A system for use with a portable wireless information device (WID) within a space, the WID including a transmitter for transmitting wireless WID signals, the system comprising:

a plurality of communication units spaced apart within the space, each unit cooperating with the WID to generate position information, the position information useable to generate a WID position estimate, the plurality of units including at least first and second sub-sets, each unit including at least one of a wireless receiver and a wireless transmitter;

at least a first receiver; and

at least a first processor linked to the at least a first receiver for receiving position information therefrom, the at least a first processor running at least first and second position estimating programs on position information associated with the first and second sub-sets, respectively, for identifying at least first and second WID position estimates within the space, respectively.

2. The system of claim 1 wherein each communication unit includes at least a wireless receiver.

3. The system of claim 2 wherein the facility area includes at least first and second regions associated with the first and second receiver sub-sets, the first region including at least a portion of the second region and the second region including at least some area outside the first region.

4. The system of claim 3 wherein the first sub-set includes at least some receivers in the second sub-set and wherein the second sub-set includes at least some receivers in addition to the receivers common to each of the first and second sub-sets.

5. The system of claim 4 wherein the first region includes at least some space outside the second region and the first sub-set also includes at least some receivers in addition to the receivers common to each of the first and second sub-sets.

6. The system of claim 1 wherein the at least a first processor, after identifying the at least first and second estimates, compares the estimates and selects one of the position estimates as the WID position.

7. The system of claim 6 wherein the process is repeated such that when a WID is moved within the space, the selected one of the position estimates may change.

8. The system of claim 7 wherein the first and second receiver sub-sets are associated with first and second regions of the space, the first and second regions including first and second region locations, respectively, and, wherein, the processor selects one of the position estimates by comparing the position estimates to the region locations of the first and second regions and selecting the position estimate at least in part as a function of the position estimate that is closest to one of the first and second region locations.

9. The system of claim 8 wherein the region locations are central points of the regions.

10. The system of claim 6 wherein the at least a first processor generates a confidence factor for each of the first and second estimates indicating a likelihood that the estimates are accurate and wherein the processor selects by comparing the confidence factors and selecting the position estimate with an associated highest confidence factor.

11. The system of claim 10 wherein the first and second sub-sets are associated with first and second regions of the space, respectively, and, wherein, the confidence factors are based at least in part on at least one of relative positions of the first and second estimates, the locations of the estimates relative to the first and second areas, recent WID position estimates, eradicity of the position information and signal to noise ratio.

12. The system of claim 1 wherein the at least a first processor, after identifying the at least first and second estimates, mathematically combines the estimates to generate a final WID position estimate.

13. The system of claim 12 wherein the at least a first processor generates a confidence factor for each of the at least first and second estimates indicating a likelihood that the estimates are accurate and wherein the processor mathematically combines as a function of the confidence factors.

14. The system of claim 13 wherein, when one of the confidence factors is substantially greater than the other of the confidence factors, the at least a first processor selects the position estimate associated with the greater of the two confidence factors.

15. The system of claim 3 wherein the space also includes N-2 additional regions, each region at least in part overlapping at least one other region, the receivers including N-2 additional sub-sets, each of the additional sub-sets associated with a different one of the additional regions, the at least a first processor running an additional N-2 position estimating programs on position information associated with the additional sub-sets for identifying N-2 additional position estimates for the WID within the space.

16. The system of claim 15 wherein the at least a first processor, after identifying N position estimates, compares the position estimates and selects one of the position estimates as a final position estimate.

17. The system of claim 16 wherein each of the regions has a region location and wherein the at least a first processor compares by comparing the position estimate associated with each region with the region location of the region.

18. The system of claim 17 wherein the region locations are central points of the regions.

19. The system of claim 15 wherein each location within the space is included in at least two different regions.

20. The system of claim 19 wherein the at least a first processor also generates a separate confidence factor for each of the N position estimates and selects one of the estimates as a final estimate at least in part as a function of the confidence factors.

21. The system of claim 15 further including M-1 additional processors wherein the first processor runs a first sub-set of the position estimating programs and each of the M-1 additional processors runs another sub-set of the position estimating programs.

22. The system of claim 21 wherein M is N and each of the processors runs a separate one of the N position estimating programs.

23. The system of claim 1 wherein the position information includes signal strength information.

24. The system of claim 2 wherein each receiver is linked to the at least a first processor and position information for each of the receivers is provided by the receiver directly to the processor.

25. The system of claim 2 wherein the position information includes signal strength information and wherein the system is for use with WIDs capable of determining signal strengths of received signals, the system further including transmitters and, wherein, the position information is generated by transmitting signals from the transmitters to the WID and receiving a packet of signal strength data back from the WID via at least one of the receivers.

26. The system of claim 1 further including at least a second processor and wherein the first processor runs the first position estimating program and the second processor runs the second position estimating program.

27. The system of claim 26 wherein the first and second processors are spaced apart within the space.

28. The system of claim 27 further including a communication network that links the receivers to each of the processors.

29. The system of claim 2 wherein the receivers are linked to the processor via a single communication network.

30. The system of claim 2 wherein at least a sub-set of the receivers also include transmitters for transmitting information to the WIDs.

31. The system of claim 1 wherein first and second regions of the space are associated with the at least first and second receiver sub-sets and each of the first and second regions includes the same portion of the space.

32. The system of claim 31 wherein the first and second position estimating programs are different.

33. The system of claim 31 wherein the first and second regions each include the entire space.

34. The system of claim 1 wherein the at least a first processor performs one of statistical analysis and a triangulation method to identify the first and second estimates.

35. The system of claim 1 wherein the at least a first processor also identifies a confidence factor for each of the estimates and, wherein, when none of the confidence factors exceeds a minimum required confidence factor, the processor performs a low confidence function.

36. The system of claim 34 wherein the low confidence function includes suggesting a learning process.

37. The system of claim 1 wherein the first and second position estimating programs are identical.

38. The system of claim 1 wherein the first and second position estimating programs are different.

39. The system of claim 1 wherein at least the first position estimating program includes different estimating algorithms as a function of the general location of the WID.

40. An apparatus for use with a portable wireless information device (WID) and a plurality of receivers spaced apart within a facility having a space, the receivers and WID cooperating to generate position information indicative of the distances of signal paths between the receivers and the WID, the apparatus comprising:

at least a first processor linked to the receivers for receiving signal strength information therefrom, the at least a first processor running at least first and second position estimating programs on signal strength information associated with first and second sub-sets of the receivers, respectively, for identifying first and second position estimates of the WID within the space, respectively.

41. The apparatus of claim 40 wherein the at least a first processor, after identifying the first and second estimates, selects one of the position estimates as a final WID position estimate.

42. The apparatus of claim 41 wherein the at least a first processor generates a confidence factor for each of the first and second estimates indicating a likelihood that the estimates are accurate and wherein the processor selects by comparing the confidence factors and selecting the position estimate with an associated highest confidence factor.

43. The apparatus of claim 42 wherein the first and second sub-sets are associated with first and second regions of the space, respectively, and, wherein, the confidence factors are based at least in part on at least one of relative positions of the first and second estimates, the locations of the estimates relative to the first and second areas, eradicity of the position information, recent position estimates and signal to noise ratio of the position information.

44. The apparatus of claim 40 wherein the position information includes signal strength information.

45. The apparatus of claim 44 wherein the processor generates a confidence factor for each of the estimates and wherein the confidence factor is at least in part based on the signal strength information.

46. The apparatus of claim 40 wherein the space also includes N-2 additional regions, each region at least in part overlapping at least one other region, the receivers including N-2 additional sub-sets, each of the additional sub-sets associated with a different one of the additional regions, the at least a first processor running an additional N-2 position estimating programs on signal strength information associated with the additional sub-sets for identifying N-2 additional position estimates for the WID within the space.

47. The apparatus of claim 46 wherein the at least a first processor, after identifying N position estimates, selects one of the position estimates as a final position estimate.

48. The apparatus of claim 45 wherein each of the regions has a region location and wherein the at least a first processor compares by comparing the position estimate associated with each region with the region location of the region.

49. The apparatus of claim 48 wherein the region locations are central points of each region.

50. The apparatus of claim 40 wherein each receiver is linked to the at least a first processor and signal strength information for each of the receivers is provided by the receiver directly to the processor.

51. The apparatus of claim 40 further including at least a second processor and wherein the first processor runs the first position estimating program and the second processor runs the second position estimating program.

52. The apparatus of claim 51 wherein the receivers are linked to the processors via a single communication network.

53. A method for use with a portable wireless information device (WID) within a space, the WID including a transmitter for transmitting wireless WID signals, the method comprising the steps of:

obtaining position information indicative of the distances of signal paths between the WID and specific locations within the space;

using a first sub-set of the position information to identify a first estimate of WID location;

using a second sub-set of the position information to identify a second estimate of WID position; and

using the first and second estimates to identifying a final estimate of the WID location.

54. The method of claim 53 wherein the step of using the first and second estimates includes generating a confidence factor for each of the estimates where the confidence factors are indicative of the accuracy of the estimates.

55. The method of claim 54 wherein the step of using the first and second estimates further includes identifying the estimate having the highest confidence factor as the final estimate.

56. The method of claim 54 further including the step of identifying first and second regions within the space that are associated with the first and second information sub-sets and wherein the step of generating confidence factors includes determining relative juxtapositions between the estimates and the first and second regions.

57. The method of claim 56 wherein the first and second regions include first and second central locations, respectively, and, wherein, the step of determining relative juxtapositions includes comparing the estimated locations to the first and second central locations.

58. The method of claim 54 wherein the step of using the first and second estimates further includes mathematically combining the first and second

estimates to provide a final estimate of WID location as a function of the confidence factors.

59. The method of claim 53 further including rendering at least one of the estimates accessible to applications requiring WID position estimates.

60. The method of claim 53 wherein the step of obtaining includes providing a separate wireless signal receiver at each of the specific locations, receiving signals from the WID and using the signals to identify the position information.

61. The method of claim 60 wherein the position information includes signal strength information and wherein the step of using the signals includes determining the signal strengths.

62. The method of claim 53 wherein the step of obtaining includes providing a separate wireless signal transmitter at each of the specific locations and at least one receiver within the space, transmitting signals from the transmitters to the WID, identifying the position information via the WID and transmitting the position information from the WID to the at least one receiver.

63. The method of claim 62 wherein the position information is signal strength information.

64. The method of claim 53 wherein first and second facility regions are associated with the first and second position information sub-sets and wherein the first and second regions overlap.

65. The method of claim 53 further including the step of using N-2 additional sub-sets of the position information to identify N-2 additional estimates of WID position wherein the step of using the first and second estimates to identify a final estimate of the WID position includes using a sub-set of the first through Nth estimates to identify a final estimate of the WID location.

66. The method of claim 65 wherein the subset of estimates includes all of the first through Nth estimates.

67. The method of claim 66 wherein the step of using the first through Nth estimates includes identifying a confidence factor for each of the N estimates.

68. The method of claim 67 wherein the step of using the first through Nth estimates further includes identifying the estimate having the highest confidence factor as the final estimate.

69. The method of claim 67 further including the step of identifying N regions within the space that are associated with the first through Nth information sub-sets and wherein the step of generating confidence factors includes determining relative juxtapositions between the estimates and the first through Nth regions.

70. The method of claim 69 wherein the step of identifying N regions includes identifying regions such that each location within the space is located within at least two separate regions.

71. The method of claim 69 wherein the first through Nth regions include first through Nth central locations, respectively, and, wherein, the step of determining relative juxtapositions includes comparing the estimated positions to the first through Nth central locations.

72. The method of claim 67 wherein the step of using the first though Nth estimates further includes mathematically combining at least a sub-set of the first through Nth estimates to provide a final estimate of WID location as a function of the confidence factors.

73. The method of claim 53 wherein the steps of using the first and second sub-sets of position information include providing a single processor running first and second programs to determine the first and second locations, respectively.

74. The method of claim 53 wherein the steps of using the first and second sub-sets of position information include providing first and second processors

running the first and second programs to determine the first and second locations, respectively.

75. The method of claim 53 further including the step of identifying first and second regions within the space that are associated with the first and second information sub-sets and wherein the first and second regions at least in part overlap.

76. The method of claim 53 wherein the step of using a first sub-set includes running a first program to estimate WID position and the step of using a second sub-set includes running a second program to estimate WID position.

77. The method of claim 76 wherein the first and second programs are different.

78. The method of claim 77 wherein the first and second sub-sets are identical.

79. The method of claim 77 wherein the first and second sub-sets are different.

80. The method of claim 76 wherein at least the first program includes at least first and second algorithms that are performed as a function of general WID location.

81. The method of claim 53 wherein the space is a three dimensional space within an automated facility.

82. A method for use with a portable wireless information device (WID) within a space, the WID including a transmitter for transmitting wireless WID signals, the method for tracking the position of the WID within the space and comprising the steps of:

obtaining position information indicative of the distances of signal paths between the WID and specific locations within the space;

attempting to use a first sub-set of the position information to identify a first estimate of WID location;

attempting to use a second sub-set of the position information to identify a second estimate of the WID location;

when one of the first and second estimates is identified, rendering the one of the first and second estimates accessible by applications requiring WID location; and

when the one of the first and second estimates is not identified and the other of the first and second estimates is identified, rendering the other of the first and second estimates accessible by applications requiring WID location.

83. The method of claim 82 further including the step of, when both the first and second estimates are identified, identifying a confidence factor for each of the first and second estimates where the confidence factors are indicative of the accuracy of the estimates and identifying the estimate associated with the greatest confidence factor as a final estimate to be rendered accessible.

84. The method of claim 82 wherein the position information includes signal strength information.

85. The method of claim 82 wherein the step of obtaining includes providing a separate wireless signal receiver at each of the specific locations, receiving signals from the WID and using the signals to identify the position information.

86. The method of claim 82 wherein the step of obtaining includes providing a separate wireless signal transmitter at each of the specific locations, transmitting signals from the transmitters to the WID, identifying the position information via the WID and transmitting the position information from the WID to the at least a first receiver.

87. A method for use with a portable wireless information device (WID) within a space, the WID including a transmitter for transmitting wireless WID signals, the method for tracking location of the WID within the space and comprising the steps of:

tracking WID location with a first wireless position estimating system to generate a first position estimate;

tracking WID location with a second wireless position estimating system to generate a second position estimate; and

using the first and second estimates to identifying a final WID position estimate.

88. The method of claim 87 wherein each of the tracking steps includes providing receivers at spaced apart specific locations within the space, receiving wireless signals transmitted by the WID and determining a location related characteristic of the received signals that is indicative of the distances of signal paths between the WID and specific locations of the receivers, the step of tracking WID location with the first system further including using a sub-set of the location related characteristics to generate the first position estimate and the step of tracking WID location with the second system further including using a sub-set of the location related characteristics to generate the second position estimate.

89. The method of claim 88 wherein the location related characteristics includes signal strength.

90. The method of claim 87 wherein the step of using the first and second estimates to identifying a final WID position estimate includes identifying the most accurate estimate of the first and second estimates as the final estimate.

91. The method of claim 90 wherein the space is an enclosed space within a facility.

92. The method of claim 87 wherein the first and second estimating systems use different algorithms to estimate WID position.

93. An apparatus for use with a portable wireless information device (WID) within a space, the WID including a transmitter for transmitting wireless WID signals, the apparatus for tracking WID location within the space and comprising:

a plurality of receivers spaced apart within the space, each receiver receiving signals transmitted by the WID and determining signal strength of the received signals, the plurality of receivers including N sub-sets of receivers associated with N separate regions within the space; and

at least a first processor linked to the receivers for receiving signal strength information therefrom, the at least a first processor running first through Nth separate position estimating programs on signal strength information associated with the first through Nth sub-sets, respectively, for identifying first through Nth estimates of the WID location within the space, respectively.

94. The apparatus of claim 93 wherein the at least a first processor, after identifying the N estimates, compares the estimates, selects one of the position estimates as the WID location and renders the selected estimate accessible to applications requiring WID location information.

95. The apparatus of claim 93 wherein the processor compares by identifying a separate confidence factor for each of the N estimates where each confidence factor estimates the accuracy of an associated estimate and comparing the confidence factors, the processor selecting the estimate associated with the highest confidence factor.

96. A method for estimating the position of a wireless information device (WID) within a space, the method comprising the steps of:

a) estimating WID position via a first estimating program;

b) identifying a confidence factor for the WID position estimate;

c) when the confidence factor meets a threshold requirement, rendering the position estimate accessible to other applications; and

d) when the confidence factor fails to meet a threshold requirement, repeating steps (a) through (c) with a second estimating program.

97. The method of claim 96 wherein step (d) is performed for each of a plurality of estimating programs until one of WID position has been estimated at least once via each of the estimating programs and an estimate that meets the threshold requirement has been identified.

98. The method of claim 97 wherein, after WID position has been estimated via each of the estimating programs, when none of the estimates meets the threshold requirement, the method includes the step of performing another function.

99. The method of claim 98 wherein the another function includes indicating that WID position is unknown.

100. A method for estimating the position of a wireless information device (WID) within a space, the method comprising the steps of:

a) generating a first WID position estimate via a first estimating program;

b) generating a second WID position estimate via a second estimating program; and

c) using the first and second estimates to identify a final WID position estimate.

101. The method of claim 100 wherein the first and second estimating programs are different.

102. The method of claim 100 further including the step of generating a confidence factor for each of the first and second estimates and wherein the step of using the first and second estimates includes using to confidence factors.

103. The method of claim 102 wherein the step of using the confidence factors includes mathematically combining the first and second estimates as a function of the confidence factors.

104. The method of claim 102 wherein the step of using the confidence factors includes the step of selecting the one of the first and second estimates that is associated with the highest confidence factor as the final estimate.

105. A method for use with a portable wireless information device (WID) within a space, the WID including a transmitter for transmitting wireless WID signals, the method for tracking the position of the WID within the space and comprising the steps of:

obtaining position information indicative of the distances of signal paths between the WID and specific locations within the space;

attempting to use a first sub-set of the position information to identify a first estimate of WID location;

attempting to use a second sub-set of the position information to identify a second estimate of the WID location;

determining if at least one of the estimates is sufficiently accurate;

when at least one of the estimates is sufficiently accurate, rendering the likely most accurate of the estimates accessible as the final estimate; and

when none of the estimates is sufficiently accurate, performing another function.

106. The method of claim 104 wherein the step of performing another function includes indicating that the WID position is unknown.

107. The method of claim 104 wherein the step of determining if at least one of the estimates is sufficiently accurate includes generating a confidence factor for each of the estimates and comparing the confidence factor to a threshold factor and, when a confidence factor is greater than the threshold factor, determining that the associated estimate is sufficiently accurate.